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Water Melon Seed (*Citrullus Lanathus*) As Potential Coagulant for Treatment of Surface Water

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***Abstract**: This paper reports the potential of watermelon seed as a natural coagulant for surface water treatment. Jar test experiments were performed on raw water from River Benue, Makurdi with initial turbidity of 58.7 NTU. These experiments were conducted to determine the effect of dosage, mixing speed and stirring time on coagulation, using watermelon seed cake as coagulant. Results obtained showed that at a dosage of 0.1g/L, stirring time of 10 minutes and mixing speed of 100rpm, the highest turbidity removal was observed. The residual turbidity at optimum dosage of watermelon seed cake had improved by 25% (14.4 NTU). This however, was above the world health organization (WHO) maximum recommended value of 5 NTU. The results showed that watermelon seeds can be used as a natural coagulant for water treatment when properly harnessed.*

***Keywords**: Watermelon, seed, water treatment, coagulant, turbidity*

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I. Introduction

Long before now, plants have been used for different reasons including treatment of various ailments. Plants can also be used for treatment of impure surface water such as rivers and streams (via coagulation and disinfection). The uses of water cannot be over emphasised as it serves domestic, industrial and public importance. In fact water is necessary for sustenance of plant and animal life [1]. Even though water is an essential commodity for humans, it can also do harm to human health if consumed (especially for drinking) without purification. The level of purity of water varies according to the purpose of its use. The common method of water treatment involves the use of aluminium sulphate (alum) and calcium hypochlorite (both synthetic) as water coagulants. These synthetic coagulants are actually expensive to purchase and are chemicals that when used for water purification may have negative effects on health if not properly administered during the water treatment process [2]. In recent years there has been considerable interest in the use of natural coagulants in place of commercial ones. Some studies on natural coagulants have been carried out and various natural coagulants have been produced or extracted from plants such as *Moringa oleifera, Prosopis juliflora, Jutropha curcas, Zea mays,Opuntia dillenii, Citrullus lanathus, and Cactus latifaria* [3-7]. Among plant materials that have been tested over the years, the seeds of *Moringa oleifera* has been shown to be the most effective natural plant coagulant for water purification, hence it can be used in place of aluminium sulphate (alum) which is commonly used around the world [4]. *Moringa oleifera* is considered safe for treatment of surface water as it has no negative health effects on consumers [5, 6]. However, the use of a natural coagulant together with a coagulant aid also gives pleasant results on treated water [7]. The advantages of using natural plant-based coagulants for water treatment is that, they are cheaper to purchase, they do not produce treated water with extreme pH and they are highly biodegradable. Natural coagulants are usually presumed safe for human health. This study investigates the possibility of using water melon seeds as natural coagulant for purification of turbid surface water.

II. Materials And Method

Sample collection

Watermelon fruits were bought from Wurukum market, Makurdi and the seeds were removed and sun dried for seven consecutive days. The raw water sample (of medium turbidity) was collected from the River Benue.

Coagulant Sample preparation

The watermelon seeds were removed from the fruits and sun dried for one week. The seeds were then ground into fine powder, using a mortar and pestle.To extract the oil from the watermelon seeds, 20g of the seed powder was dissolved in 200mL normal hexane, stirred for 30 minutes with the aid of a magnetic stirrer and then filtered [8]. The solid residue (seed cake) from the filtration was rinsed with distilled water and dried in an oven at 80^oC until a constant weight was obtained.

Extraction of coagulant active agents

12g of the watermelon seed cake was weighed and dissolved in 1000mL tap water (12gL-1 stock solution of the sample) and stirred for 15 minutes, to obtain the crude extracts of watermelon seeds. Tap water was used instead of distilled water, because it contains more dissolved ions, allowing easier dissolution of the active agent, thereby enhancing coagulation activity of the natural coagulant. It is reported that the coagulating protein is more soluble in water with high concentration of ions [9].

Preparation of turbid water sample

The raw water used in the jar test was collected from River Benue in a 20 Litre jerry can and yellow clayey soil was added to the water in the jerry can to increase its turbidity. The jerry can was thereafter shaken to ensure even distribution of the clay particles in the water. The prepared water was then allowed to stand overnight and the turbidity, pH, colour, TDS and conductivity of the turbid water determined and recorded.

Determination of water quality parameters on raw water

Turbidity

The turbidity of the water sample was measured before and after treatment using a ‘‘Eutech TC201’’ turbidimeter.

Colour

The colour of the water sample was carried out before and after the Jar test, using a ‘’HACH DR/2000’’ spectrophotometer. The first sample cell (blank) was filled with distilled water and the other with the water sample, which was filtered prior to this procedure and measured.

Conductivity

The conductivity test was done using a ‘‘Eutech CON 700’’ conductivity/TDS meter. The conductivity meter probe was inserted into the sample, making sure it did not touch the beaker. The reading was recorded from the LCD display after it had stabilized.

Total dissolved solids

The Total Dissolved Solids (TDS) value was simultaneously displayed and taken with the conductivity (dual display) when measuring the conductivity, using a ‘‘EutechCON 700’’conductivity/TDS meter.

PHand Temperature

The pH of the samples was read using a calibrated Eutech-700 pH meter. A volume (roughly 200mL) of the supernatant from the beaker containing the treated sample was transferred into another beaker and the pH meter probe was then inserted into the sample and measurement taken.

Jar Test Experiment

The Jar test setup was employed to carryout flocculation on the samples and to determine the effects of coagulant dosage, stirring time and stirring speed on coagulation. Five different beakers containing different weights (0.1 - 0.5g, at 0.1g intervals) of watermelon seed stock solution in 250mL of the test water sample were used to determine the optimum coagulant dosage. A sixth beaker was used as a blank water sample with 0.0g of the coagulant. Rapid flocculation was done at 120 rpm for 3 minutes and then slow flocculation was done at 40 rpm for 15 minutes with same initial dosages. The samples were then left for 30 minutes to settle (sedimentation time) and then the determination of some water quality parameters were carried out on the samples from each beaker. The coagulant dosage that gave the best turbidity and colour removal (optimum coagulant dosage) was taken as the optimum dosage. The above flocculation process was repeated with the optimum dosage (0.1g) in all the samples. The stirring time was also varied at 2minutes, 5minutes, 8minutes, 10minutes and 12minutes respectively for the five beakers and the optimum stirring time determined. Again, the flocculation speed was varied between 50rpm – 250rpm at 50rpm intervals and the stirring speed found.

The coagulation activity of the coagulant was determined using the formula below;

Coagulation activity (%) = (RTB – RTs / RTB) x 100

Where;

RTB represents residual turbidity of blank sample and RTS the residual turbidity of treated sample.

III. Results

Table 1: Raw water analysis

Parameter	Result
Turbidity (NTU)	58.7
pH	6.72
Temperature (^{0}C)	24.5

Colour (TCU)	325
TDS (mg/L)	212
Conductivity (µS/cm)	436

Table 2: Effect of coagulant dosage of water melon seed cake on coagulation

S/N	Dosage (g/L)	Turbidity (NTU)	pH	Temp. (°C)	Colour (TCU)	TDS (mg/L)	EC (µS/cm)
1	0.1	14.4	6.56	26.0	80	233	476
2	0.2	15.5	6.40	25.4	85	239	463
3	0.3	15.0	6.23	25.5	80	257	479
4	0.4	17.0	6.19	25.9	90	251	453
5	0.5	18.9	6.20	25.4	130	242	434
6	0.0	55.7	6.54	25.3	310	208	429

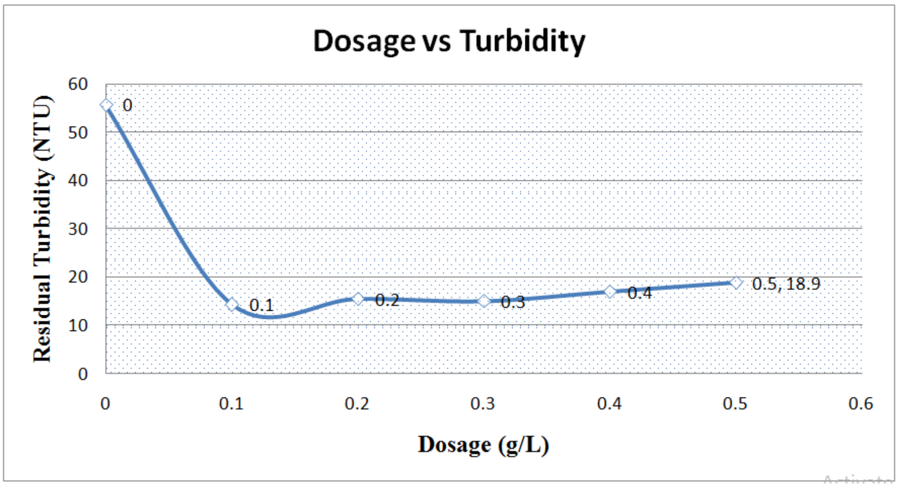

Figure 1: Effect of coagulation dosage on turbidity

Table 3: Effect of mixing speed on coagulation, using 0.1g/L water melon seed stock solution

S/N	Speed (rpm)	Turbidity (NTU)	pH	Temp. (°C)	Colour (TCU)	TDS (mg/L)	EC (µS/cm)
1	50	9.6	5.50	26.1	60	233	476
2	100	9.3	5.45	26.0	50	239	463
3	150	11.3	5.33	26.8	65	251 257	479
4	200	10.7	5.21	25.0	65	242	453
5	250	11.8	5.14	25.4	70		434

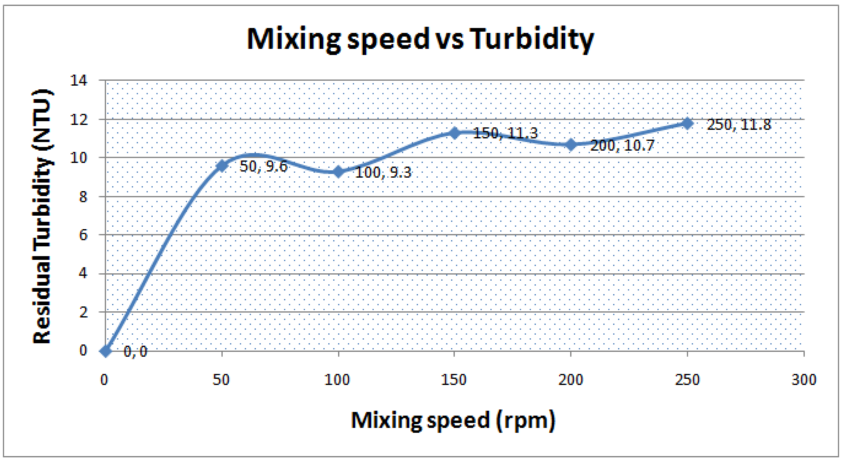

Figure 2: Effect of mixing speed on coagulation, using 0.1g/L watermelon seed stock solution

Table 4: Effect of stirring timeon coagulation, at 100rpm and 0.1g/L water melon seed stock solution

S/N	Time (min)	Turbidity (NTU)	pH	Temp. (^oC)	Colour (TCU)	TDS (mg/L)	EC (μS/cm)
1	2	13.2	5.50	26.1	60	233	476
2	5	12.6	5.45	26.0	50	239	463
3	8	10.7	5.33	26.8	65	251 257	479
4	10	10.2	5.21	25.0	65	242	453
5	12	12.0	5.14	25.4	70		434

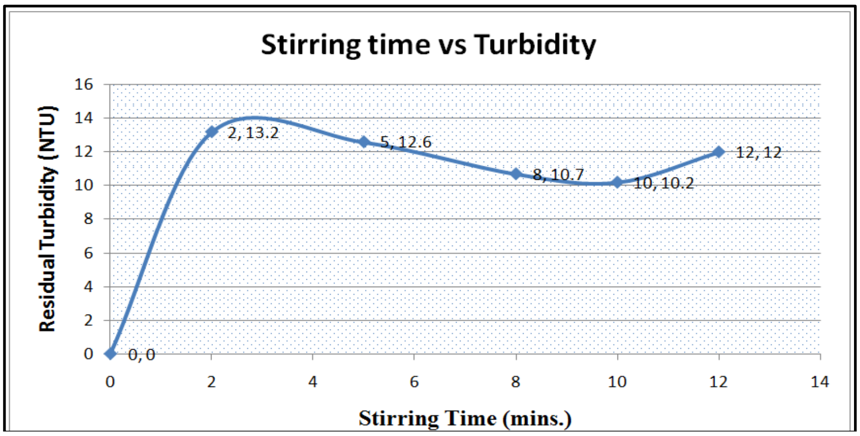

Figure3: Effect of stirring time on turbidity

IV. Discussion

The results obtained from Table 2 showed that, a dosage of 0.1g/L watermelon seed stock solution gave the highest turbidity removal (75%). The coagulation efficiency of the coagulant at the optimum dosage (0.1g/L) was derived thus;

Coagulation efficiency (%) = (RTB – RTs / RTB) x 100

Where;RTB represents residual turbidity of blank sample and RTS the residual turbidity of treated sample

RTB = 55.7NTU; RTS = 14.4NTU

Coagulation efficiency (%) = 55.7 – 14.4/ 55.7 x 100

Coagulation efficiency = 41.3/55.7 x 100 = 75%

Results from Table 3 showed that the optimum mixing speed using the optimum dosage was 100 rpm. At 100rpm, the residual turbidity of the treated water dropped to 9.3 NTU which is below the initial residual turbidity of 14.4 NTU at 0.1g/L coagulant dosage. This means that mixing speed has a significant effect on the initial turbidity of raw water. When stirring time was varied between 2minutes and 12minutes, the highest turbidity removal was obtained at 10minutes as shown in Table 4.The residual turbidity after 10minutes was 10.2 NTU.

It was generally observed from Table 2 to Table 4 that, the TDS and Conductivity increased with coagulant dosage. This increase is probably due to the presence of dissolved ions (Sodium, Potassium, Calcium, Magnesium and/or Iron) in the tap water used for making stock solutions of the coagulant.

V. Conclusion

Data obtained from this work have shown that the crude extracts of watermelon seeds can be used as a safe and cost effective means of wastewater purification. This is highly recommended for water treatment in developing countries, especially in the rural communities, where people have little or no access to clean drinking water. The data obtained showed that watermelon seeds had a good turbidity and colour removal thus can be used in the treatment of wastewater.

References

[1] Poornima, S. (2016). Natural Coagulants for Water Purification: An Ecofriendly Approach, World Journal of Pharmaceutical Research, 5(5): 1-5

[2] Muhammad, I.M., Abdulsalam, S., Abdulkarim, A. and Bello, A.A. (2015). Water Melon Seed as a Potential Coagulant for Water Treatment; Global Journal of Researches in Engineering,15 (1): 2-5

[3] Sowmeyan, R., Santhosh, J. and Latha, R. (2011). Effectiveness of herbs in community water treatment. International Research Journal of Biochemistry and Bioinformatics 1(11): 1-2

[4] Idris, M.A., Jami, M.S., Hammed, A.M and Jamal, P. (2016). Moringa oleifera seed extract: A review on its environmental Applications, International Journal of Applied Environmental Sciences 11(6):1470

[5] Oloruntade, A. J., Afuye, G. G. (2013). A Case for the use of Moringa Oleifera as a Natural Coagulant to improve Water Supply in Rural Farms in Nigeria, Academic Research International 4(6): 1
[6] Ali, E.N., Muyibi, S.A., Salleh, H.M., Salleh, M.R.M. and Alam, M.Z. (2009). Moringa oleifera Seeds As Natural Coagulant For Water Treatmant, Thirteenth International Water Technology Conference, Hurghada, Egypt 13: 163-167
[7] Renuka, M.S., Binayke, A., Jadhav, M.V. (2013). Application of Natural Coagulants in Water Purification; International Journal of Advanced Technology in Civil Engineering, 2: 1-5
[8] Okuda, T., Baes, A.U., Nishijima, W. and Okada, M. (2001). Isolation and Characterization of Coagulant extracted from Moringa oleifera seed by salt solution, Water Research 35(3):830-834
[9] Amagloh, F.K. and Benang, A. (2009). Effectiveness of Moringa oleifera Seed as Coagulant for Water Purification, African Journal of Agricultural Research 4(1): 119-121

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